INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN: 2278 – 0211 (Online)

Effect Of Main Steam Temperature At Inlet On Turbine Shaft Vibration

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Abstract:
Now our country India is becoming emerging power on world map. To improve lifestyle of middle class as well as to make sufficient growth in GDP we should ensure availability of sufficient power generation to fulfill our requirements. As we all know that for maintenance purpose there is large amount of loss of power taking place due to shutdowns and breakdowns. The new generation of condition monitoring and diagnostics system plays an important role in efficient functioning of power plants. Most rotating machine defects can be detected by such a system much before a dangerous situation occurs. It allows the efficient use of stationary on-line continuous monitoring system for condition monitoring and diagnostics as well. Vibration monitoring for condition monitoring of turbine shaft can reduce expenses of maintenance of turbo generator of power plants as well as prevent unnecessary shutdown of plant, which create power crisis. Condition monitoring can be mainly performed by vibration measurement and signal analysis but now days as life going faster and faster we cannot afford loss of time and also we want more accuracy in measurement system to ensure continuous running of our plants without taking any shut down. To ensure that we can perform condition monitoring properly, sensors and user interactive programs helps them for continuous monitoring of each and every parameter at a time. They can monitor each and every parameter with help of those systems known as turbine supervisory instruments (T.S.I). There is lot of research going on this topic. Turbo visionary parameters are also very important part of health diagnosis system of turbo generator. Particularly lube oil temperature is very important parameter to monitor because they have much influence on turbine shaft vibration and also governing systems are available for change values of those parameters. Now a days real time monitoring reduces breakdowns to a large extent. We can conduct it with help of sensors and analyzers with software. T.S.I includes various velocity transducers, accelerometers and LVDT's with suitable automation and software for proper human interaction. By the help of real time monitoring we can assure continuous power supply without any catastrophic failure. The object of this paper is to identify influence of main steam temperature at inlet on turbine shaft vibration at turbo generator at unit-6 (195 MW), Kota super thermal power station by measuring vibration amplitude and analyzing problem with help of Matlab.

Keywords: *Main Steam Temperature at inlet, Turbine shaft displacement, Axial Shift, HPT, IPT, LPT*

1.Introduction

The steam system supplies steam from the boiler to the turbine .since this is the main source of energy transport it is a critical component of plant. Valves control the admission of steam to the turbine and the system has a number of other components not rally regarded as part of the steam system but which rely on steam for their operation. The steam system for boiler includes a reheater which reheates steam leaving at high pressure turbine (HPT) using live steam directly from the boiler. Most system includes a deareator for eliminating air and also preheating it prior to feeding it to boiler. All systems have feed water heater which use steam bled from turbine to preheat feed water going to boiler. The last component of steam system is condenser where exhaust steam finally condensed before being pumped back to boiler. The purpose of main steam system is to convey steam from the steam generating unit where it produced to the steam turbine which it drives to produce electrical power. Naturally a large amount of energy is conveyed in the system which operates under high pressures and temperatures. In coal fired steam generating units, steam generated at high pressures and high temperatures. It is partly expanded in the high pressure cylinder of the turbine and then returned to the boiler at an intermediate pressure for reheating to the same temperature. It then goes to the intermediate and low pressure cylinders of turbine to complete its expansion. Reheating is necessary to ensure that the steam after completing expansion in turbine is not too wet. The flow of high pressure steam entering the turbine is controlled by governor valves and stop valves. The control valves controls the flow to ensure that the appropriate amount of steam enters the turbine to meet the electrical load demand while also they can close rapidly in as emergency to shut off the steam supply to turbine. The flow of steam in intermediate pressure region, reheat steam in controlled in a similar manner. Although the reheat governor and stop valves are downstream of the main steam valves, a considerable amount of steam remains with in the high pressure turbine. Without reheat governor and stop valves, this steam would after a load reduction, enter and continue to drive the intermediate pressure turbine (IPT) and low pressure turbine (LPT) while it expands down to a new lower pressure. This effect is most severe with a total load reduction as would occur in the event of fault and tripping of turbine.

2.Observation

My observations are related to measure effect of various parameters on vibration of turbo generator at unit-6 at kota super thermal power station (KSTPS). As we have discussed above that there are various kind of vibrations in turbo-generator but I have observed that displacements are excessive in shafts as compare to bearings because at bearings, due to lubrication and cooling, horizontal as well as vertical displacement reduces considerably. I have observed that during period of February 2012 to May 2012, many times maximum displacement of shaft at horizontal and vertical direction was higher than its designated safe value of 200 microns. To analyze that we took readings regarding shaft vibrations and lube oil temperature surrounding to that particular peak value and analyze them in matlab to find effect of each parameter on shaft displacement and shaft.

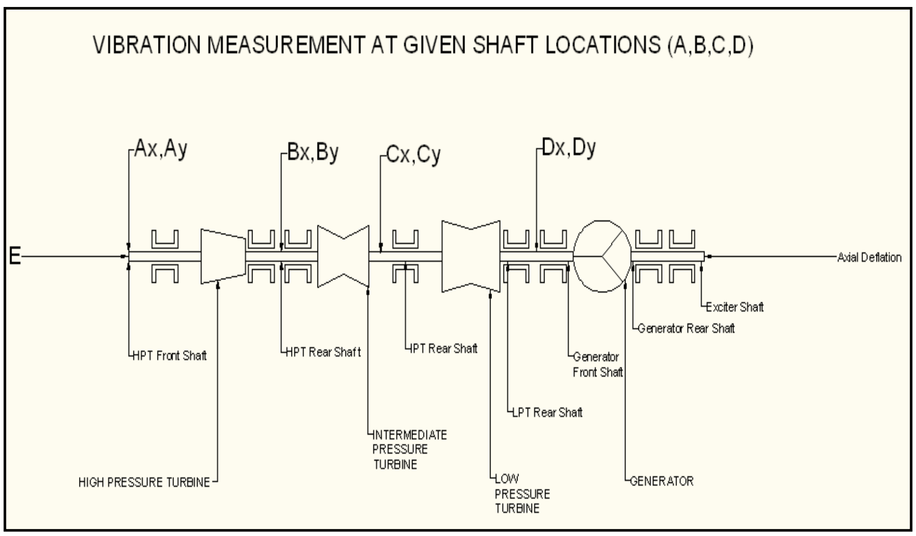

Figure1: Vibration measurement at given shaft locations

2.1.H. Types Of Bearings

- Number-1, 3, 4,5,6,7 are Radial Journal Bearings.
- Number-2 is Thrust Bearing and Radial Journal Bearing.

Shaft vibration measurement conducted at eight places with five parameters as shown in given table.

Sr. No	Abbreviation	Parameter	Unit
1	Ax	HPT Front, Shaft Displacement along X direction	Microns
2	Ay	HPT Front, Shaft Displacement along Y direction	Microns
3	Bx	HPT Rear, Shaft Displacement along X direction	Microns
4	By	HPT Rear, Shaft Displacement along Y direction	Microns
5	Cx	IPT Rear, Shaft Displacement along X direction	Microns
6	Cy	IPT Rear, Shaft Displacement along Y direction	Microns
7	Dx	LPT Rear, Shaft Displacement along X direction	Microns
8	Dy	LPT Rear, Shaft Displacement along Y direction	Microns
9	X	Main Steam Temperature at Inlet	°C
10	E	Axial Shift	Unit less

Table 1: Abbreviations and units of various parameters

Sr. No	Parameter	Designated Safe Value	Tripping Value
1	Shaft Displacement	200 Microns	300 Microns
2	Bearing Pedestal Displacement	50 Microns	120 Microns
3	Axial Shift	(+/-) 0.5	(+/-) 1
4	Main Steam Temperature at Inlet	535°C	545°C

Table 2: Designated Safe values of various parameters during running condition of turbo generator

3.Analysis And Result

Analysis of observed data has performed with help of analyzing software MATLAB. By those programs I got two plots related to each parameter i.e.

- Time Vs Parameter
- Parameter Vs Shaft displacement

Maximum displacement has observed in HPT front shaft along Y direction.

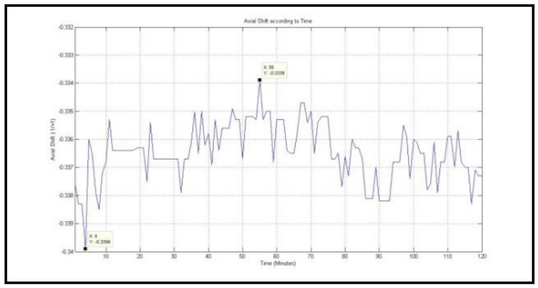

Figure 2 (a): Time E

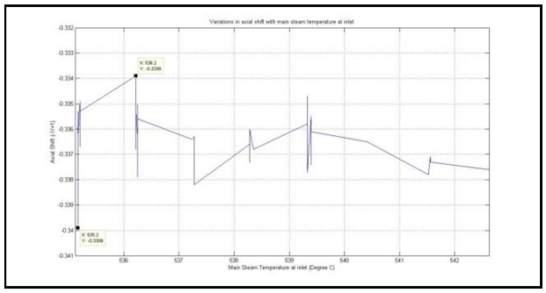

Figure 2 (b): X-E

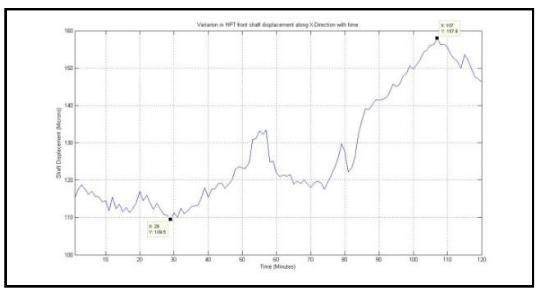

Figure3(a): Time-Ax

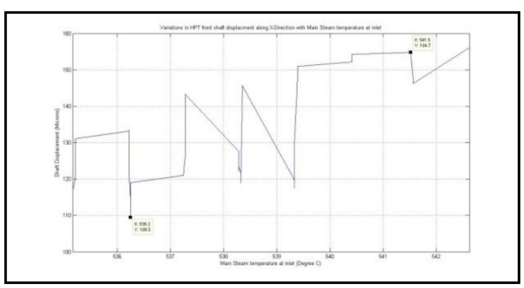

Figure 3(b): X-Ax

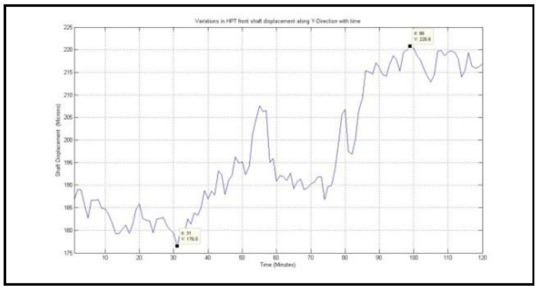

Figure 4 (a) : Time-Ay

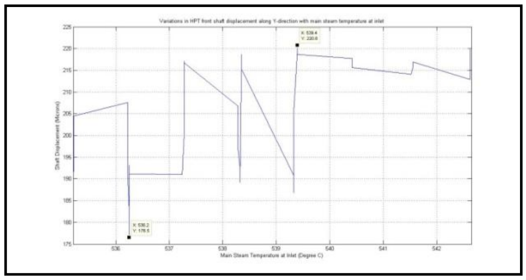

Figure 4(b): X-Ay

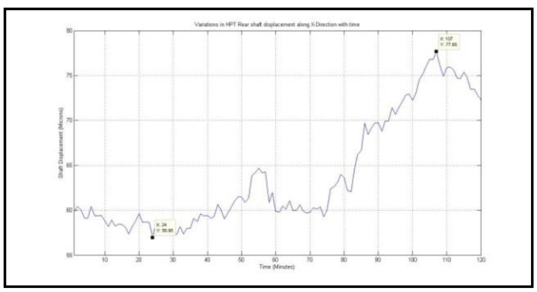

Figure5(a): Time-Bx

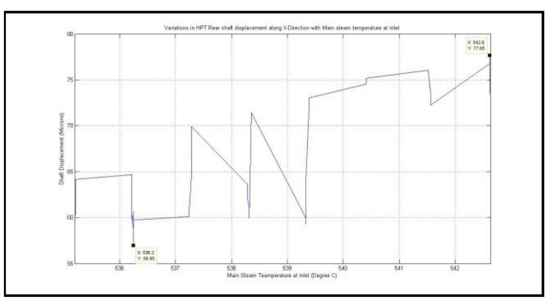

Figure 5(b): X-Bx

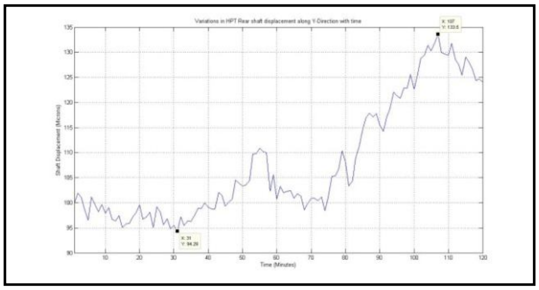

Figure 6 (a): Time-By

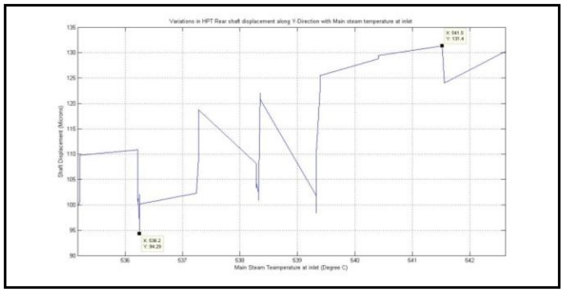

Figure 6 (b) : X-By

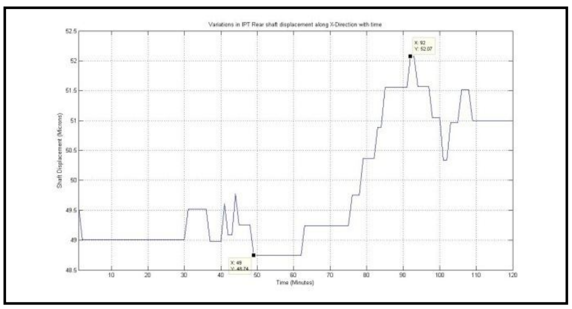

Figure7 (a): Time-Cx

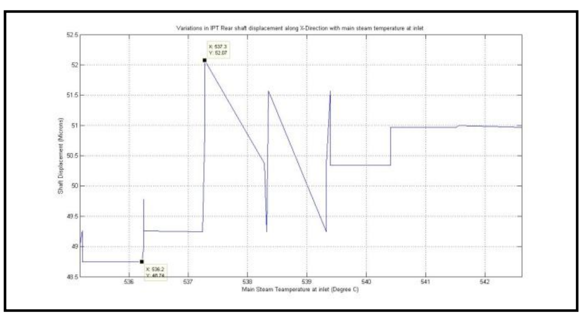

Figure7(b): X-Cx

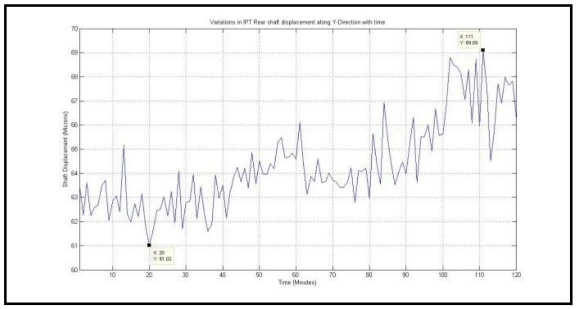

Figure 8(a) : Time-Cy

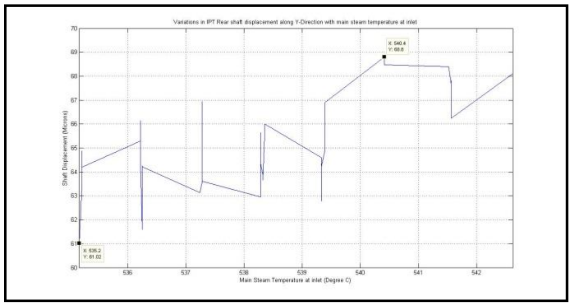

Figure 8(b) : X-Cy

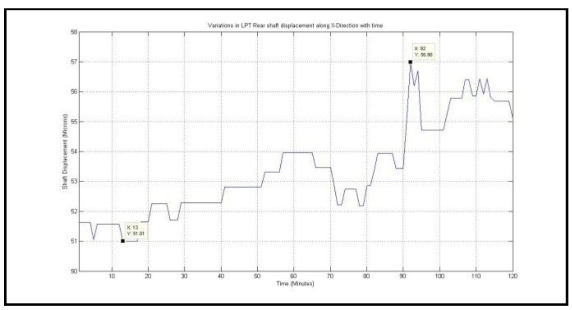

Figure 9 (a): Time-Dx

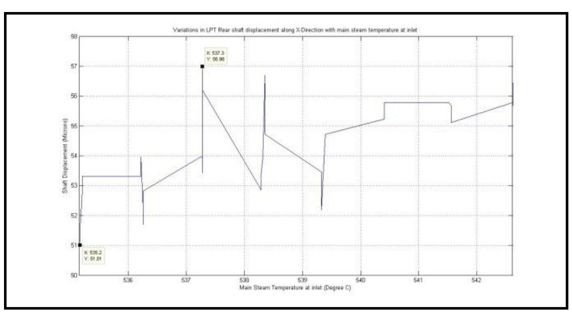

Figure 9(b): X-Dx

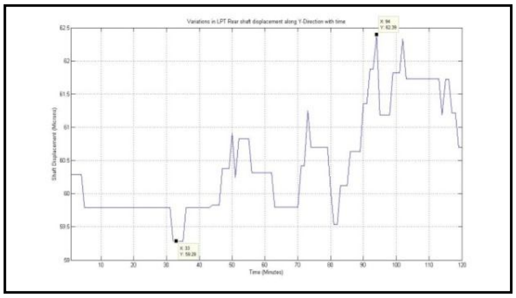

Figure10(a) : Time-Dy

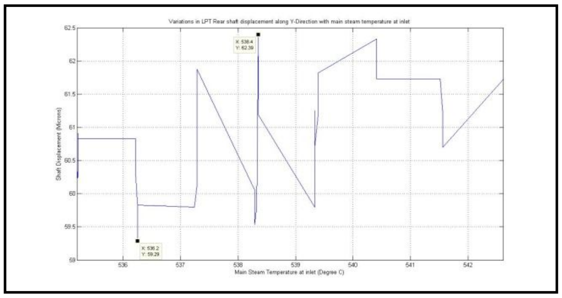

Figure 10(b): X-Dy

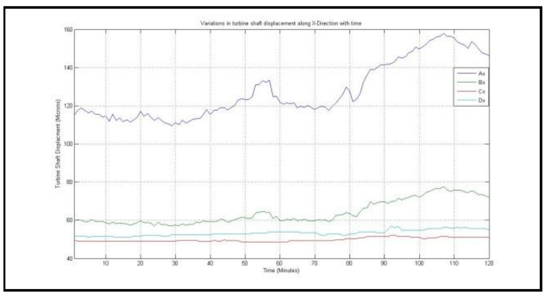

Figure11(a) : Time-Ax, Bx, Cx, Dx

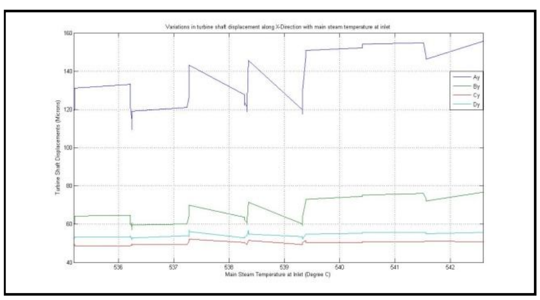

Figure 11(b): X-Ax, Bx, Cx, Dx

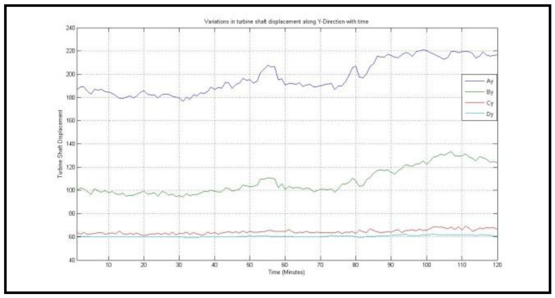

Figure12 (a) : Time-Ay, By, Cy, Dy

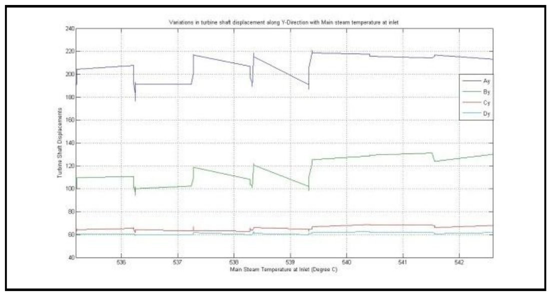

Figure 12 (b): X-Ay,By,Cy,Dy

Sr. No	Abbreviations of parameter	Maximum value of Shaft displacement	Corresponding value of Main Steam temperature at inlet (°C)	Designated safe value of parameter	Designated safe value of Main Steam temperature at Inlet W (°C)
1	E	-0.3339	536.2	-0.5	540
2	Ax	154.7 Microns	541.5	200 Microns	540
3	Ay	220.8 Microns	539.4	200 Microns	540
4	Bx	77.65 Microns	542.6	200 Microns	540
5	By	131.4 Microns	541.5	200 Microns	540
6	Cx	52.07 Microns	537.3	200 Microns	540

7	Cy	68.8 Microns	540.4	200 Microns	540
8	Dx	56.98 Microns	537.3	200 Microns	540
9	Dy	62.39 Microns	538.4	200 Microns	540

Table 3: Results from figures

4.Conclusion

- In most of the cases, Turbine shaft displacements are maximum when main steam temperature at inlet is higher than its designated safe value.
- Displacement of HPT front shaft at Y-direction (Ay) is maximum and it is also higher than its designated safe value.
- Corresponding value of main steam temperature at inlet of Ay is also closer than its designated safe value.
- Value of turbine shaft displacements are as per following order:
  Cx<Dx<Dy<Cy<Bx<By<Ax<Ay.

  It is due to bearing supports and cantilever situation of turbine shaft at some positions.

  So finally we can make conclusion that displacement of turbine shaft increases when main steam temperature at inlet is higher than its designated safe value.

5.Reference

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